Space Travel

Computational Investigation of Shuttle Leading Edge Defects

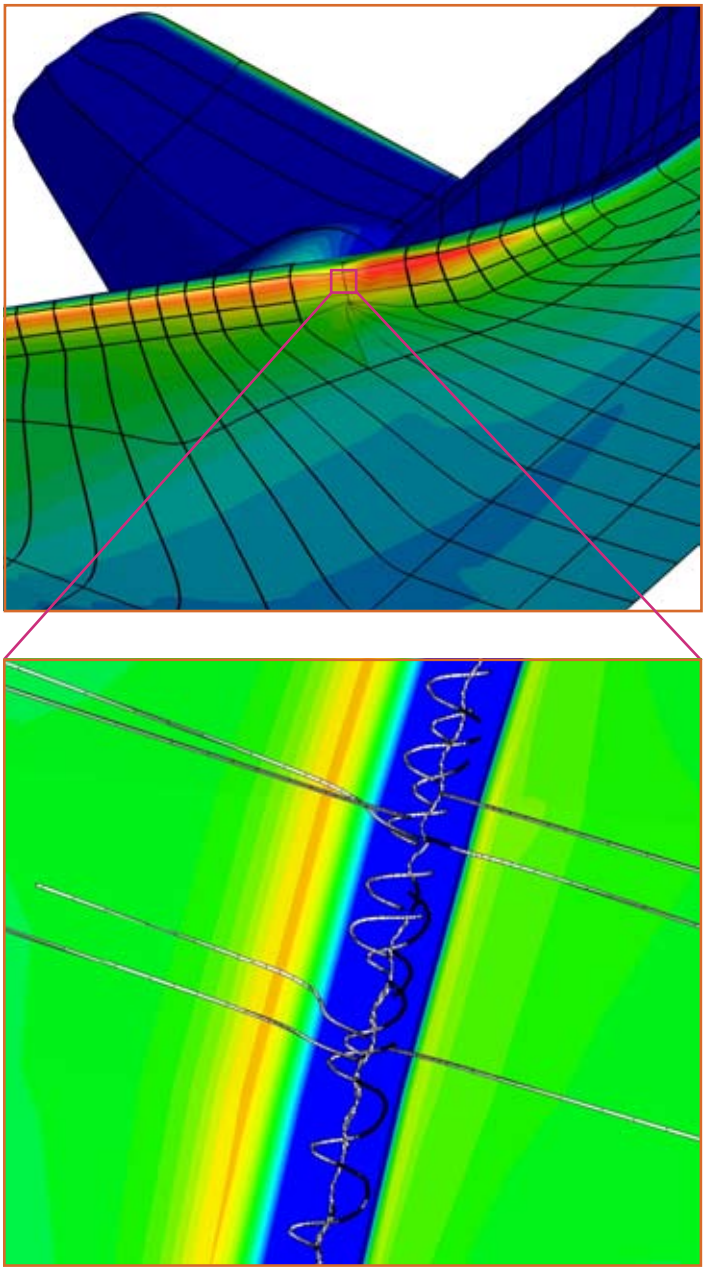
NASA has been conducting ongoing investigations of the Space Shuttle Orbiter systems since the Columbia disaster in 2002. Numerous issues with deteroriation of shuttle leading edge material in the vicinity of the peak heating region were identified. To assess the safety risk of these defects, a variety of studies were performed to determine the root cause of these issues.

- This particular investigation focuses on assessing aggravated thermal environments at the peak temperature region of the leading edge—previous investigations found degraded Reinforced Carbon-Carbon (RCC) laminates used in the construction of the leading edge
- High-resolution computations of the smallest details of the leading edge RCC region were performed to assess flowfield and thermodynamic effects of key segments of the leading edge
- These segments, including RCC panels that extend along the leading edge, with seals inserted between the panels, have small, thin gaps that permit pressurization of the leading edge during reentry
- Computations identified that flow is not ingested into the wing leading edge as surmised, but stagnates near the peak temperature region, providing more information about the physical phenomena along the leading edge

Though no conclusive evidence came from this study, it was an important step in an overall process of elimination of reasons for the defects to occur.

In addition, for ongoing shuttle missions, the NASA Advanced Supercomputing facility enables the rapid assessment of the aerodynamic and thermodynamic environment occurring along the leading edge during the shuttle's reentry to Earth. Computational assessments requested by the NASA Engineering and Safety Center are performed in a matter days.

Surface temperature of the shuttle orbiter during reentry with detailed accommodation of a wing leading edge gap. Previous investigations found degraded Reinforced Carbon-Carbon (RCC) laminates used in the construction of the leading edge.



Flowfield structure of gap region near peak temperature along the wing leading edge.

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